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THE RAINFALL OF OCTOBER.

Taken generally, October is England's wettest month, and the month just passed has assuredly maintained this characteristic. Reference to our usual Monthly Table shows, however, that though general, the excessive rainfall has been by no means universal. Kent, Suffolk, and Lancashire, have had little more rain than usual, and in N. Yorkshire, Northumberland, Cumberland, and parts of Scotland, there has been a deficiency. How, it will be asked, can this be reconciled with the constant reports of floods all over the country. There are two answers to this remark, firstly, that it is usual for that which is general to be considered as universal; and, secondly, there have been most exceptionally heavy and continuous rains, and they, in most cases, have fallen on saturated ground. The fall of October 9th was discussed in our last; the end of the year draws nigh, when it will be our duty to thoroughly describe the features of the rainfall of 1875, we therefore refrain from giving more than a few typical letters, and an abstract of the returns from Exeter, which is quite disheartening, and to other observers will, we hope, be a warning. If observers do not like, in accordance with Rule XVI., to obtain new rain gauges, they might at least see that when very heavy rains occur, the gauge is emptied before it overflows. As, however, they may be absent or asleep, the moral is obvious: Provide yourself with a gauge of ample capacity.

Rainfall in Exeter and the immediate vicinity, Oct. 19th.

STATIONS.	18th.	19th	20th	21st
Exeter Institution	·74	3·26	·20	·42
,, Manston Terrace ...	·75	? (1)	·37	·41
,, High Street	·75	? (2)	·21	·41
,, ,, ,, ...	·73	? (3)	·21	·41
,, Brampford Speke ...	·61	2·39	·22	·36
Topsham, Clyst St. George.	Fall fr	om 4th	to 21s	t, 5·50

(1)—Gauge overflowed.
(2) } Gauges overflowed; they held 2·75 in., so that the fall exceeded that, but by how
(3) } much is not known.

To the Editor of the Meteorological Magazine.

SIR,—A multitude of correspondence—alike trying to your time and patience to wade through—will, of course, reach you on the subject of the heavy rainfalls, with which most parts of this country have recently been visited; but as the more the information you receive the greater is the power afforded you of accurately judging the full nature and extent of the visitation, no apology is, I hope, necessary for contributing my mite to the general mass.

A wet period set in here on the 17th of September, and lasted up to the 30th of October. Out of the forty-four days constituting this period, rain was measured on thirty-two of them to the extent, in all, of 9·97 in. The rainfall for October alone was 7·36 in., an amount unprecedented, for the time, in my ten years' experience of this locality. Some of the falls, too, during the above-named time are specially worthy of notice, as, for instance, that of the 19th of September, when 0·62 in. fell in twenty minutes—accompanying a thunderstorm; and, again, that of the 2nd of October, 1 in. in two hours. The 1·16 in. taken on the morning of the 10th of October, was also the heaviest fall within twenty-four hours, I have ever yet recorded in that month. The Avon, which runs past my house within half-a-mile, overflowed its banks, and remained out for a longer time than I have ever known it, frequent as these over-flowings are.

I remain, Sir, yours truly,

F. BONNYCASTLE GRITTON.

Tytherton-Lucas, Chippenham, Wilts,
1st Nov., 1875.

P.S.—Appended is an abstract from my rainfall register.

Sept. 17	0·01	Sept. 29	—	Oct. 11	0·01	Oct. 23	0·22
18	—	30	0·01	12	—	24	—
19	0·62	Oct. 1	0·04	13	—	25	—
20	0·06	2	1·00	14	0·10	26	0·87
21	0·73	3	0·23	15	—	27	0·50
22	0·11	4	—	16	0·01	28	0·19
23	0·30	5	0·02	17	—	29	—
24	0·10	6	—	18	0·38	30	0·03
25	0·01	7	—	19	0·79	31	—
26	0·05	8	0·02	20	0·12		
27	0·38	9	1·16	21	0·61	Total	9·97
28	0·23	10	0·23	22	0·83		

Total for October ... 7·36.

To the Editor of the Meteorological Magazine.

SIR,—This month has been by far the wettest observed by me during 24 years, the rainfall exceeding by 1·5 inches that of November, 1872. It has also afforded the wettest day (3·25 in. on the 9th) since 1860, when I began daily registration, and probably within living memory. The greatest daily rain I have previously had (1·65 in. on Sept. 29th, 1871), being very little more than half the amount. October has been the wettest month in the year five times since 1852, (in 1853, 4·25 in.;

1855, 5·03 in.; 1865, 4·08 in.; 1870, 3·84 in.; 1875, 7·80 in.;) but in no instance since 1860 until now, has the greatest daily fall amounted to 1 in. There have been only 18 instances of more than 1 inch of rain in the 24 hours since 1860. The average fall for October in 23 years was 2·62 inches: including the present, it has been 2·84 inches.

The morning of the 9th was very foggy. Temperature at 9 a.m., 50·3; bar., 29·386 (59°); wind S. and light. As the fog cleared away, light clouds were seen, and occasionally the sky became overcast, and a few drops of rain fell. About noon continuous rain began, the sky became very dark, and the rain soon fell in torrents, with hardly an interval of mitigation, until 10 p.m., when it measured 3·18 inches. Soon after this it nearly ceased; thus 3 in. fell in nine hours. The temperature during the rain was 43°. Towards evening, the wind, which had changed to E. and N.W., blew in gusts with great force, uprooting trees and dislodging chimney-pots. In the night the waters from the sources of the Cherwell, on the hills bordering the upper Cherwell valley, came down with such unwonted rapidity, that by 7 a.m. on the following morning, the Great Western Railway at the Banbury Station platform was two feet under water (not four feet, as reported by penny-a-liners). Across the line, which is raised several feet above the valley, the water rushed from the east, or Northampton side, and tumbled in a turbi-cascade into the river and meadows on the west, and thence across the towing path into the canal, where a heavily laden coal barge was swamped, and an empty one lifted on to the towing path lower down. At noon the flood had fallen considerably, but was still rushing with great velocity along the valley.

This flood had but just left our meadows, when, on the night of the 18th, heavy rain came on with high wind from S.E., continuing during the whole of the 19th and part of the 20th, the wind still S.E. The whole rain measured 2·54 inches. This brought another great flood, not quite so high with us, the greatest depth of water at G. W. R. station not exceeding one foot. But below us it was higher than the first, the former flood not having passed away.

Yours truly,

E. BEESLEY.

Banbury.

To the Editor of the Meteorological Magazine.

SIR,—I enclose a table of hourly rainfall for the wet week ending October 23rd, as recorded by my 12 inch electrical gauge, three feet above ground. As usual, when rain falls with easterly winds, we had no more than fell in the plains, and the quantity was insufficient to raise the river more than half the height to which it was raised by the storm of October 21st, 1874, when, I believe, no rain fell at York. The comparative absence of "Scotch mist" has been remarkable this

summer, and I doubt whether the rainfall in mountain districts will exceed the average, unless S.W. winds set in in December.

FENWICK W. STOW.

Hestholm, Bedale, Oct. 27th, 1875.

Rainfall at Hestholm, Wensleydale, for week ending October 23rd, 1875.

(12 inch gauge, 3 feet above ground, 465 above sea.

Hour ending (Gnwch time).	17	18	19	20	21	22	23	Total	Hour ending (Gnwch time).	17	18	19	20	21	22	23	Total
a.m.									p.m.								
1	...	...	·01	·01	·01	...	·03	·06	1	...	·01	·02	·02	...	..	·08	·13
2	...	...	·01	·03	·01	...	·09	·14	2	...	·01	·02	·05	...	...	·14	·22
3	...	...	...	·06	·01	...	·01	·08	3	...	·02	·03	·17	...	·02	·02	·26
4	...	...	...	·06	...	..	..	·06	4	...	...	·04	·18	..	·08	...	·30
5	...	...	...	·02	...	...	...	·02	5	..	·03	·01	·10	...	·04	·03	·21
6	.	...	·02	·01	...	...	...	·03	6	..	...	·05	·04	...	·09	·02	·20
7	...	·02	·07	·01	...	..	·01	·11	7	..	·01	·12	·05	·03	...	...	·21
8	...	·02	·09	·02	...	...	·01	·14	8	...	·03	·16	·07	·09	...	...	·35
9	..	·01	·01	·01	...	...	...	·03	9	...	·02	·04	·08	·04	·01	...	·19
10	...	·01	·01	...	...	...	·06	·08	10	...	...	·02	·06	...	·11	...	·19
11	...	·01	·02	...	...	..	·09	·12	11	...	...	·01	·10	...	·03	...	·14
12	...	·04	·03	...	...	...	·05	·12	12	...	·01	...	·05	...	·02	...	·08

Total same gauge measured at 9 a.m. (local time).

17th		18th		19th		20th		21st		22nd		23rd		Total.
·050	...	·405	...	·840	...	·995	...	·160	...	·580	...	·512	...	3·542

Total in 5 inch gauge at 1 ft., 3·57 inches.

To the Editor of the Meteorological Magazine.

SIR,—As the rainfall of October has been much above the average, I send you a comparative table of the last 10 years here :—

in.	in.	in.	in.	in.
1866...3·17	1868...2·16	1870...7·39	1872...3·88	1874...3·87
1867 ..3·83	1869...1·26	1871...3·24	1873...3·29	1875...6·74

From this it appears the fall has been much above that of other years, with the exception of 1870. There were only seven days without rain. The daily fall was as follows :—

	in.		in.		in.		in.
Oct.	1...0·11	Oct.	9... —	Oct.	17...0·05	Oct.	25...1·04
	2... —		10...0·06		18...0·50		26...1·34
	3...0·24		11... —		19...0·07		27...0·64
	4...0·02		12...0·06		20...0·18		28...0·20
	5... —		13...0·32		21...0·28		29...0·15
	6... —		14...0·08		22...0·14		30...0·16
	7... —		15...0·02		23...0·17		31...0·22
	8...0·25		16...0·44		24... —		
							6·74

I remain, your obedient servant,

SAMUEL P. WARREN.

The Parsonage, Balbriggan, Co. Dublin.

To the Editor of the Meteorological Magazine.

SIR,—I send you particulars of daily rainfall, June to October. The period is especially remarkable for the large quantities of rain falling in short spaces of time.

June 9–15	...	7 days	...	1·68 in.
,, 27–July 3	...	7 ,,	...	3·08 ,,
July 14–20	...	7 ,,	...	5·58 ,, (!)
Aug. 6–11	...	6 ,,	...	1·98 ,,
Sept. 19–23	...	5 ,,	...	2·96 ,,
Oct. 9–10	...	2 ,,	...	1·38 ,,
,, 18–22	...	5 ,,	...	3·69 ,, (!)
		39 days.		20·35 in.

Very respectfully,
JOHN THRUSTANS.

Merridale, Wolverhampton, Nov. 6th, 1875.

Rainfall at Wolverhampton, 1875.

	June. in.	July. in.	August. in.	September. in.	October. in.
1	—	0·30	—	—	0·08
2	—	0·81	—	0·31	0·10
3	—	0·37	—	0·35	0·21
4	—	—	—	—	—
5	—	—	0·08	—	0·05
6	0·02	—	0·21	—	—
7	—	—	0·49	—	0·02
8	—	0·02	0·39	0·30	—
9	0·25	0·41	—	—	0·97
10	0·35	0·18	0·13	—	0·41
11	0·11	0·13	0·76	—	0·03
12	0·37	—	0·07	—	0·05
13	0·31	—	0·05	—	—
14	0·01	1·19	0·13	—	0·21
15	0·28	0·38	—	—	0·04
16	—	—	—	—	—
17	0·06	0·11	0·02	0·05	—
18	—	0·66	—	—	0·64
19	0·08	0·45	—	1·45	1·36
20	—	2·79	—	0·12	1·00
21	—	0·03	—	0·70	0·30
22	—	—	—	0·05	0·39
23	—	0·14	—	0·64	—
24	—	—	—	0·06	—
25	0·02	0·15	0·09	0·10	—
26	—	—	—	0·02	0·37
27	0·24	—	—	0·13	0·32
28	0·43	—	0·22	0·19	0·38
29	0·82	0·02	—	0·03	—
30	0·11	—	0·11	0·05	—
31		—	—		—
	3·46	8·14	2·75	4·55	6·93

REDUCTION OF BAROMETER TO SEA LEVEL.

To the Editor of the Meteorological Magazine.

SIR,—In your September Magazine (which I saw yesterday for the first time), at the foot of page 120, your correspondent notices an error in my postscript (my letter to you under date, 23rd April); he is quite correct; a few hours after I sent you the proof of the above communication, I wrote to you that the co-efficient employed by Buchan (from Laplace), should be ·00222 in lieu of ·004; you replied that the correction was too late for that month, (the printing was earlier than usual on account of the Whitsun holidays), but it would appear as "errata" in the following magazine. The correction, however, did *not* appear as *promised*. Will you kindly put me right by mentioning this in your next impression?

Glaisher's Rain Gauge as per Mr. Rawson's letter in September Magazine.—The first gauge I had was one of these, I did not wait for the heavy rain, but before I fixed it, I poured a jug of water into the funnel and found only a few drops ran into the receiver, the bulk of the water forcing itself out in the way described by Mr. Rawson. I immediately had the bent tube straightened.

I am, dear Sir, yours faithfully,

KAUFMANN J. MARKS.

14, *Warrington Crescent, Maida Hill, W.*, 20*th October*, 1875.

EARTHQUAKE.

To the Editor of the Meteorological Magazine.

SIR,—At the same hour, three minutes to 10 p.m., of September 23rd, as mentioned by your correspondent "J. D. P.," I and all my household heard and felt very distinctly the shock of an earthquake, at Oughtershaw Hall, in Langstrothdale, Upper Wharfedale, 1,200 feet above the sea, 6 miles distant from Hawes in Upper Wensleydale.

In so remote a district, and at such an hour, our attention was at once called to the unusual sound, resembling the passing of heavily laden wagons. We went out of doors to assure ourselves more fully: the night was very dark, the day had been cool and stormy, after great heat and heavy thunderstorms during several preceding days. I did not observe any particular change in the barometer.

The same shock was heard and felt at Buckden, 6 miles distant, and at other places in the neighbourhood, and was recognised as an earthquake shock, as they are of no very infrequent occurrence. A very noted one took place on 15th December, 1859, which, from a number of observations I gathered at the time, seems to have traversed with its greatest intensity the line of the "great Craven Fault," near Settle, and forwards towards Greenhow Hill, by Grassington—a noted area of peculiar disturbance and upheaval.—Yours truly,

CHARLES H. L. WOODD.

Roslyn, Hampstead, N.W., 16*th October*, 1875.

THE BRITISH ASSOCIATION AT BRISTOL.

(Continued from page 141.*)*

Prof. Osborne Reynolds read a paper *On the Refraction of Sound by the Atmosphere*, in which he remarked that in previous papers he had pointed out that the upward diminution of temperature in the atmosphere (shown by Mr. Glaisher's balloon ascents to exist under certain circumstances) must refract and give an upward direction to the rays of sound which would otherwise proceed horizontally, and it was suggested that this might be the cause of the observed difference of the distinctness with which similar sounds were heard on different occasions, particularly of the very marked advantage that the night has over the day in this respect. On this subject he had made a series of experiments. He mentioned a case in which at sea, when leaving a yacht in a small boat, for the purpose of making experiments on sound, those in the yacht and the boat were able to call to one another, and be heard at a distance of three-and-a-half miles, and that the hiss and report of a rocket sent up from the yacht was heard at a distance of five miles. Also on the same occasion the barking of a dog on shore, which was eight miles distant, was heard, and the paddles of a steamer, which must have been fifteen miles off, were distinctly audible. Prof. Reynolds remarked that the distinctness with which sounds of such comparatively low intensity could be heard was perhaps beyond anything definitely on record, although remarkable instances of sounds heard a long way off were occasionally reported. As the result of a series of experiments made by means of an electric bell, Prof. Reynolds found that when the sky was cloudy and there was no dew, the sound could invariably be heard much further with, than against, the wind; but when the sky was clear, and there was a heavy dew, the sound could be heard as far against a light wind as with it. On one occasion in which the wind was very light and the thermometer showed 39° at one foot above the grass, and 47° at eight feet, the sound was heard 440 yards against the wind, and only 270 yards with it.

Dr. Janssen made some observations relative to *Mirage at Sea*. He had paid great attention to the phenomena in all his journeys since 1868, and had observed some very curious facts relating to mirage chiefly at sunrise and sunset. He found that (1) the mirage was almost constant at the surface of the sea; (2) that the appearances were explained by admitting the existence of a plane of total reflection at a certain height above the sea; (3) that the phenomena are due to a thermic and hygrometric action of the sea on the neighbouring atmospheric strata; (4) that there exist at sea direct, inverse, lateral, and other mirages; (5) that the phenomena have a very general influence on the apparent height of the sea horizon, which is sometimes diminished, sometimes increased. Considering the use made of the horizon in nautical astronomy it is very important to take into account this variation of the apparent horizon.

Prof. Hennessy, of Dublin, read two papers, one *On the influence of the physical properties of water on climate*, and the other *On the possible influence on climate of the substitution of water for land in Central and Northern Africa*. In the former the author referred to his earlier writings, in which he had taken an opposite view to Sir John Herschel, who stated that the effect of land under sunshine was to throw heat into the general atmosphere, and to distribute it over the whole earth, by the carrying power of the air, and that water was much less effective in this respect, the heat penetrating its depths and being there absorbed, so that the surface never acquires a very elevated temperature, even under the equator. Prof. Hennessy had arrived at the conclusion that of all substances largely existing in nature, water was that which was the most favourable to the absorption and distribution of solar heat throughout the external coating of the earth.

In his second paper the author referred to the fact that more than six years' since he had put forward proofs of the connection between some of the hot winds that blow from the south-west in Central and Southern Europe and the currents

of the Atlantic, and not with the Desert of Sahara, as has been usually supposed. Similar views had been enunciated by Prof. Wild, director of the Physical Observatory of Russia, and by others. The attention excited by the great midday heat of Central Africa caused many to overlook its remarkably low nocturnal temperature, and thus to ascribe to the desert a thermal influence that it does not possess. The author's views with regard to the physical properties of water in connection with climate, indicate that the substitution of an area of water over the Sahara for the existing dry land would be followed by the storing up of the heat received so largely in that region from the sun's rays which is now partly dissipated by nocturnal radiation. A great mediterranean sea in Africa would become a source of positive thermal influence on distant places. In the Red Sea the temperature is high by night as well as by day, and this would also occur in the hypothetical Mediterranean of the Sahara. The climatic effect of this sea would upon the whole result in a higher mean temperature for these parts of the globe, and it would undoubtedly not operate in producing a lower temperature in Europe so as to cause a descent of the snow line. Its operation would probably be the reverse.

In a letter from Mr. Meldrum, of Mauritius Observatory, written to accompany forty-nine tables respecting *Sunspots and Rainfall* (which, however, had not arrived), he expressed an opinion that the evidence adduced in favourof a rainfall periodicity was so strong that he believed we should by and bye be able to predict the general character of the seasons.

The Report of the Committee on Luminous Meteors, was read by Prof. Herschel, it related, as usual, to meteors doubly observed, and to aërolites, the portion having reference to the latter being the more interesting, as the falls of aërolites which have been placed on record since the last report were more than ordinarily numerous.

During the annual meteor showers of the past year, very unfavourable weather generally prevailed for recording meteor tracks, and few meteors were seen on those nights when the usual expectations of their appearance were entertained. A thorough examination of all the observations collected by the committee since the publication of the Meteor Atlas in 1867, with the view of extending and correcting the list of general and occasional meteoric showers which it embraced, has been continued with satisfactory results under the direction of Mr. Greg. The report also contained a *résumé* of the contents of the recent publications on the subject of meteoric astronomy.

Mr. Glaisher remarked that the report was the result of considerable labour performed by Prof. A. S. Herschel, but he pointed out that the work of properly treating meteor observations had now become so great as to be beyond the power of the Association to grapple with, and alluded with satisfaction to the arrangements being carried out by M. Leverrier. A discussion took place on the connection of comets and meteors, in the course of which Sir William Thompson said that there was nothing to justify the assertion that the mass of comets was so small as was sometimes supposed, and he considered there was good evidence for believing that the comet's tail was really a train of meteors.

The Report of the Committee on British Rainfall, was epitomized by the Secretary, Mr. G. J. Symons, it began by giving a *résumé* of the rainfall work done in connection with the British Association during the last fourteen years. It then referred to the steps takenafter the meeting at Belfast to obtain additional stations in Ireland, which were so successful that the Committee received 190 offers of assistance The acceptance of all these offers would have involved an expenditure far beyond the funds at the disposal of the committee, and they were therefore reluctantly compelled to make a careful selection, resulting, however, in the establishment of sixty-six stations, many of them in localities of extreme importance. In the past fifteen years the number of stations had been raised from 241 to nearly 2,000. The influence of size and shape on the indications of rain gauges had been experimentally examined, and also the effect of height above ground. The laws which

regulate the seasonal distribution of rainfall had been, to a certain extent, ascertained. The secular variation of annual fall had been approximately determined. A code of rules had been drawn up for observers. Nearly 250 stations have been started at the cost of the Association, and 629 stations have been visited, and the gauges examined by the secretary. The Committee had obtained and supported observations on mountain tops, and places difficult of access, where no observations had been made, in Cumberland, Westmoreland, Wales, and Scotland, and also an extensive series in Ireland. When the works actually in hand are completed, they will furnish an index to all the observations hitherto made, and be invaluable to future enquirers.

Captain H. Toynbee, F.R.A.S., F.R.E.S., Marine Superintendent of the Meteorological Office, read a paper on the *Physical Geography of that part of the Atlantic Doldrums which lies in the Track of Ships crossing the Equator.* The paper was accompanied by monthly diagrams, which showed :—1st. The isobaric lines of mean pressure for each ·05 of an inch, together with arrows showing the prevailing winds and their force. 2nd. The isothermal lines for every two degrees of air temperature. 3rd. The isothermal lines for every two degrees of sea temperature, together with arrows showing the prevailing currents and their speed in twenty-four hours. The paper called attention to important facts relating to atmospheric pressure, temperature, wind, currents, weather, sea, clouds, natural history, earthquakes, &c. The diagrams may be said to give the navigator a monthly picture of the Doldrums, clearly showing him how in some months they are wedge-shaped (as remarked by the late Commodore Maury), and enabling sailors to select the best route across the Equator. They also illustrate the action of both air and water when meeting, as is constantly the case with the two trade winds, showing how the air as well as water seems to eddy round a point of land from which the main stream is running. The district is the birthplace of many West India hurricanes, and on the diagram for August the place in which one originated was pointed out, which was afterwards traced to the Island of St. Thomas. The whole paper was a *résumé* of a large book about to be published by the Meteorological Office.

Mr. F. Galton said that the work of the Meteorological Office was a national work, and the £10,000 a year granted by Government to the office was really a very small sum compared with the amount paid by the United States for similar purposes.

Col. Carrington said that the Government of the United States had not only enlarged its facilities for home signal service, but they had recently sent two frigates across the Pacific to obtain soundings, in order to determine the practicability of establishing a Pacific telegraph.

Professor Hennessy considered that all recent researches tended to prove that the old theory of water being colder than the air and decreasing the temperature was incorrect, and that the water really was warmer than the air.

Dr. Carpenter considered it a remarkable circumstance that in the equatorial Atlantic, even in the month of August, the sea temperature was not higher than he had seen it in the same month in the Mediterranean, namely, 75°, while in the Red Sea it rose to nearly 25° above that figure. He accounted for this by the theory of a constant upward movement of the glacial water in the equatorial region, which kept down what would otherwise be a Red Sea temperature in the Atlantic.

The Wind and Gravitation Theories of Oceanic Circulation, by Mr. Jas. Croll. The paper stated that the researches of the Challenger Expedition bring to light the striking fact that the general surface of the North Atlantic to be in equilibrium must stand at a higher level than at the Equator; in other words, the surface of the Atlantic is lowest at the Equator, and rises with a gentle slope to well nigh the latitude of England—a result which proves the physical impossibility, in so far as the North Atlantic is concerned, of any general interchange of Equatorial and Polar water due to gravitation. Another fact irreconcilable with the gravitation theory is the fact that the warm water is all in the North Atlantic. According to the wind theory of oceanic circulation, however, the

whole of the phenomena are easily explained. Owing to the fact that the south-east trades are stronger than the north-east, and blow constantly over upon the northern hemisphere, the warm surface water of the South Atlantic is drifted across the Equator. It is then carried by the equatorial current into the Gulf of Mexico, and afterwards of course forms a part of the Gulf Stream. The North Atlantic, on the other hand, not only does not lose its surface heat like the equatorial and South Atlantic, but in addition it receives the enormous amount of heat constantly carried into it by the Gulf Stream.

Bearings of Recent Observations on the doctrine of Oceanic Circulation. Dr. Carpenter delivered an address on this subject. Referring first to Mr. Croll's paper, he said that there could be no doubt that a horizontal circulation existed in the North Atlantic, produced by the winds, but it was merely on the surface and did not affect the doctrine of a general oceanic circulation. Mr. Croll's contention that in order to have equilibrium the water at the Equator must be lower than further north, was an assumption which was open to considerable question, for he (Dr. Carpenter) maintained that there was a constant disturbance of equilibrium, just as in a boiler of water when fire was placed under it. Dr. Carpenter then described his theory of a general oceanic circulation, and after referring to the facts which had led him to his conclusions, said that the voyage of the Challenger showed, as he had predicted, that on the border of the Antarctic regions there is a surface stratum of cold water caused by the influence of the warmer water below and the sun melting the ice, but that cold water is lighter than the warm water below, because it is much less saline. The lower stratum of water of 36° could only be accounted for by the supposition that it was brought there by a force which drew it into the polar area. The address was almost wholly a repetition of previous addresses on the same subject.

Sir Wm. Thompson said that Dr. Carpenter's demonstration of his theory was most conclusive. The reasons he had given were utterly irrefragable. He hoped some attention would be paid to the question *where* the cold surface current, the warmer north current, and the cold southern under-current met.

REVIEWS.

Annual Report of the Chief Signal-Officer, to the Secretary of War for the year 1874. Washington: Government Printing Office, 1874. 8vo, 403 pp., 64 plates.

If any readers doubt that it is possible to make Meteorology popularly interesting, they had better try to obtain a copy of the above work, and we undertake that they will be convinced before they have read half of Sergeant Seyboth's record of the observatory on Pike's Peak, Colorado, 14,093 ft. above sea level. As perhaps all may not be able to see the original work, we quote the remarks on one fairly average week :—

"May 22nd. Summer appears to have commenced at last, even on Pike's Peak, for throughout to-day the thermometer stood above 30°, and reached a maximum of 42° at noon. Base Station reports a maximum of 93°. Two thunderstorms passed below the Peak, both advancing from the north-west to the south and east, and disappearing in the north-east. Sunset was extremely beautiful; rose colored streamers like festoons extended from clouds to plains in fantastic combinations, exhibiting splendid contrasts of light and shade.

"May 24th. A heavy thunderstorm passed slowly and directly over the Peak between 10 a.m. and 3 p.m.; the temperature declined during its passage, and large sparks passed constantly through the lightning-arrester, while a strange crackling of the snow could be heard at all times. While making the 2 p.m. out-door observations, I heard the snow crackle as mentioned, and at the same

time I felt on both temples, directly below the brass buttons on my cap, a pain as if from a slight burn; putting up my hands there was a sharp crack, and all pain had disappeared.

"May 29th. A violent thunderstorm, accompanied by sleet, passed over the Peak from south-south-east to west-north-west. It came upon us so suddenly that I had barely time to cut out the telegraph instrument before blinding flashes of fire came into both rooms from the lightning-arrester and stoves; loud reports followed in rapid succession, while outside the noise of thunder claps was almost drowned by the rattling of the indescribably heavy showers of sleet which followed each discharge. The storm appeared to surround us in all directions. At 7 p.m. a bolt struck close to the north window, and at the same time a heavy discharge took place through the lightning arrester which made me for a moment believe that the building itself had been struck, and was on fire; a cloud of smoke filled the embrasure of the north window which was afterwards found to have resulted from the melting of the rubber insulation on the office-wires. On account of the smallness of the office room, I considered it safer to retreat to the kitchen, where I found both assistants about to run, under the belief that the house was on fire. After this discharge the storm passed slowly to the westward, and we were already beginning to breathe more freely, when the wind veered to the south-west and brought back the storm in all its fury.

We are, however, bound to regard this report solely from a scientific stand-point, and we are glad to say that in this aspect also it will bear favourable comparison with any similar work. General Myers and his staff are very wise in developing to the utmost the relation of Meteorology to practical life, and in quoting in their reports not merely the usual meteorological data, but circumstances affected thereby, such as the temperature and level of rivers, their obstruction by, or freedom from, ice; the influence of rains on cereal and other crops, &c. We do not notice any detailed account of the position, mode of mounting, or pattern of the instruments employed, but this information may have been given in some other publication which we have not received. It would be certainly more interesting to Meteorologists than some of the documents which go to swell this bulky volume—*e.g.*, than the paper giving the Code words. If, however, this and all the necessary papers referring to questions of discipline, list of sergeants who have passed their examinations, and all others inseparable from a military system be expunged; the residue is a useful storehouse of well-arranged facts, illustrated by a large number of maps and diagrams equally good in design and execution.

Stanford's Orographical Map of the British Isles. Edited by PROF. A. C. RAMSAY, LL.D., F.R.S. Single sheet, 5ft. by 4ft. Stanford; London, 1875.

A SHORT time since, in answer to a casual question respecting some place in the Tyrol, the writer carelessly replied, "Oh, I know my own country far better than any foreign part." The questioner, who was a travelled Englishman, replied that he thought that that soon would be, if it was not already, a proud thing to say, considering how people now swarmed along beaten tracks abroad, and left the beauties of their native land unknown and unheeded. The advantage of repeating this bit of gossip may not be obvious, and it may therefore be well to

remark that it is only quoted as a species of credential, for surely those who know a country best are likely to be the most competent critics of its graphical representation.

The qualifications of a map are accuracy, distinctness, and neatness of execution.

If the Ordnance Survey Office had published the 6 inch maps for the whole kingdom, the duties of the Editor of this map would have been merely to see that the various contours were properly transferred; but as there are only a few counties for which these details are published, all kinds of original data must have been utilized, and the labour of compilation excessive. We are glad to find that extreme accuracy has been attained even in those parts where the Ordnance authorities have hardly done anything. We have examined at least a dozen localities where errors were probable, and have only found one case which could be improved if the draughtsman went to the spot. The 250 ft. contour is a trifle too far inland, near Ilfracombe; Hillsborough, which is a mile or two east of Ilfracombe, must be quite 400 ft., and is almost precipitous to the water's edge. Our readers will realize the hypercriticism of this remark when we state that this error arises from a deviation of perhaps 0·05 in. in a map comprising about 3000 square inches. We need not, and probably could not, give higher testimony to the accuracy of the map.

In point of distinctness, there is nothing to complain of, except, perhaps, that one of the colours is scarcely true to its name. The text says :—

Land below 250 ft., light green.
,, 250 ft. to 500 ft., dark green.
,, 500 ft. to 2000 ft., burnt sienna.
Land above 2000 ft., red.

But the pale green is so pale that it would pass equaly well for pale yellow. The colours are well chosen, and the general effect is very good, as is also the execution of the work.

In a spare corner south of Ireland there is a rainfall Map of the British Isles on a reduced scale—about 90 miles to an inch—tinted to show six separate districts—viz., those where the rainfall is (1) below 25 in., (2) between 25 in. and 30 in., (3) between 30 in. and 40 in., (4) between 40 in. and 50 in., (5) between 50 in. and 75 in., (6) above 75 in.

BOOKS RECEIVED.

AUSTRALIA.

ELLERY, R. L. J. Results of Observations in Meteorology, Terrestrial Magnetism, &c., taken at the Melbourne Observatory during the year 1872. 8vo.

RUSSELL, H. C., B.A., F.R.A.S. Meteorological Observations made at the Government Observatory, Sydney, Jan.-April, 1875.

BELGIUM.

QUETELET, E. Note sur la direction de l'Aiguille Aimantée à Bruxelles en 1875. 8vo.

,, Annales de l'Observatoire Royale de Bruxelles. Août 1875. 4to.

OCTOBER, 1875.

div.		STATIONS. [The Roman numerals denote the division of the Annual Tables to which each station belongs.]	RAINFALL. Total Fall.	Difference from average 1860–5	Greatest Fall in 24 hours. Dpth	Date.	Days on which .01 or more fell.	TEMPERATURE. Max. Deg.	Date.	Min. Deg.	Date.	No. of Nights below 32°. In shade	On grass
			inches	inches.	in.								
I.	ENGLAND.	Camden Town	4·35	+ 1·76	·79	18	18	70·2	5	32·8	13	0	0
II.		Maidstone (Linton Park)	3·85	+ ·75	·91	2	19	67·0	5	32·0	12†	3	...
,,		Selborne (The Wakes)	5·83	+ 1·62	1·45	19	18	64·5	5	32·5	17	0	4
III.		Hitchen	3·94	+ 1·39	·96	9	15	63·0	5	31·0	12	2	...
,,		Banbury	7·80	+ 5·37	3·25	9	18	67·0	5	29·0	13	..	3
IV.		Bury St. Edmunds (Culford)	3·24	+ ·53	·74	2	14	69·0	5	30·0	11‡	4	6
V.		Bridport	7·19	+ 3·16	·90	26	25	66·0	4, 5	30·0	10	...	...
,,		Barnstaple	6·40	+ 2·28	·95	1	27	66·0	20	39·0	29	0	...
,,		Bodmin	9·06	+ 3·74	1·80	26	25	63·0	5	38·0	13	0	...
VI.		Cirencester	7·82	+ 4·33	1·74	9	16	...	...	...	...	...	...
,,		Shifnal (Haughton Hall)	5·32	+ 3·08	1·27	19	18	66·0	21	32·0	12‖	3	6
,,		Tenbury (Orleton)	5·94	+ 2·71	1·04	19	20	67·5	4	29·2	13	2	7
VII.		Leicester (Belmont Villas)	5·78	...	2·24	9	17	65·8	4	30·8	13	1	..
,,		Boston	3·50	+ 1·38	1·39	20	13	68·0	5	34·0	12	0	...
,,		Grimsby (Killingholme)	4·16	...	1·15	20	20	64·0	4	31·0	13	1	...
VIII.		Manchester	4·46	+ ·65	·90	19	14	64·8	1	30·8	14	4	5
IX.		York	4·21	+ 1·69	1·25	20	17	67·0	21	31·0	11	1	..
,,		Skipton (Arncliffe)	5·14	— 1·52	·82	19	23	62·0	1	28·0	12	4	...
X.		North Shields	3·26	— ·02	·90	20	22	65·3	1	31·0	13	2	3
,,		Borrowdale (Seathwaite)	10·08	— 6·24	2·21	10	19	...	...	...	...	...	...
XI.	WALES.	Cardiff (Ely)	8·03	+ 2·28	·93	22*	24	...	...	...	...	...	...
,,		Haverfordwest	7·28	+ 2·09	·80	22	24	62·5	3	32·5	15	0	4
,,		Rhayader (Cefnfaes)	...	...	...	...	...	...	...	...	...	...	...
,,		Llandudno	5·30	+ 1·34	·85	11	20	66·5	1	36·4	14	...	...
XII.	SCOTLAND.	Dumfries (Crichton Asylum)	4·82	— ·35	·97	20	19	63·7	2	29·0	13	2	4
,,		Hawick (Silverbut Hall)	2·54	...	·29	19	21	...	...	...	...	...	...
XIV.		Kilmarnock (Annanhill)	3·72	...	·46	26	19	59·7	9	31·2	10	2	4
XV.		Castle Toward	6·72	+ ·97	·90	18	19	62·0	1	...	...	...	..
XVI.		Leven (Nookton)	4·03	+ ·28	·56	13	24	62·0	1	30·0	12	0	7
,,		Stirling (Deanston)	...	...	...	...	...	...	...	...	...	...	...
,,		Grandtully	6·27	...	·80	22	28	...	...	..	...	...	...
XVII.		Braemar	5·54	+ 2·79	·59	14	27	58·8	5	25·8	12	3	8
,,		Aberdeen	4·10	...	·51	13	25	62·5	4	31·2	12	2	4
XVIII		Loch Broom	2·97	...	·66	5	15	...	...	...	..	...	...
,,		Portree	5·31	— 5·47	·98	8	21	...	...	...	...	...	...
,,		Inverness (Culloden)	1·33	— 1·33	·30	7	22	60·5	8	29·0	31	5	11
XIX.		Helmsdale	3·44	...	·85	12	24	...	...	...	...	...	...
,,		Sandwick	3·76	— 1·16	·65	6	24	57·5	8	35·8	13	0	4
XX.	IRELAND.	Caherciveen Darrynane Abbey	6·96	...	1·25	29	24	...	...	...	...	...	...
,,		Cork	6·69	...	1·40	26	23	...	...	...	...	...	...
,,		Waterford	9·89	+ 5·49	1·57	31	22	66·0	4	30·0	15	...	...
,,		Killaloe	5·06	+ ·04	·55	2	22	67·0	4	31·0	17	...	...
XXI.		Portarlington	4·71	— ·42	·76	19	29	60·5	7	31·5	13	1	...
,,		Monkstown, Dublin	7·64	+ 3·72	1·19	26	25	...	...	...	...	...	...
XXII.		Galway	3·57	...	·45	17	23	...	...	...	...	.	...
,,		Ballyshannon	4·54	...	·60	27	22	...	...	...	...	...	...
XXIII		Waringstown	3·93	...	·65	26	24	63·0	8	30·0	11	5	5
,,		Edenfel Omagh)	5·13	...	·91	26	20	59·0	4	29·0	9§	5	...

* And 26. † 13 & 25. ‡ 12. ‖ 17. § 11 & 12.

+Shows that the fall was above the average; —that it was below it.

METEOROLOGICAL NOTES ON OCTOBER.

ABBREVIATIONS.—Bar. for Barometer; Ther. for Thermometer; Max. for Maximum; Min. for Minimum; T for Thunder; L for Lightning; T S for Thunderstorm; R for Rain; H for Hail; S for Snow.

ENGLAND.

LINTON.—The beginning and middle of the month mostly wet, with a flood in the river about the 22nd; slight frosts on the 12th, 13th, and 25th, but not severe enough to injure geraniums out of doors. Bar. very low and unsteady from 9th to 16th, without any apparent cause for it being so. Winds changeable, but never very high; on the whole the month not remarkable for October.

SELBORNE.—Bar. higher on the 6th than it has been since the 1st of April; frost on grass on 11th, 12th, 17th, and 25th; fog on 1st, 12th, 19th, 20th, 25th, and the last four days of the month. Prevailing winds first half of the month S.W., towards the end S.E. to N.E. A gloomy, cheerless, foggy month.

BANBURY.—T on 2nd; great fall of R (3·25 in.) on 9th, during the continuance of which the temp. fell from 50°·3 to 43°·0. On the following day the greatest flood this year, nearly 2 inches of R fell during the 19th and 20th; followed on the 21st by a great flood R and sleet on 27th.

CULFORD.—High wind on 9th and 18th; T on 11th. A month of comparatively sunless weather, particularly as regards the latter part of it. Easterly winds prevailing on 18 days. Mean temp. of the month 48°·8.

BODMIN.—Mean bar. 29·74 in.; mean temp. 52°·9. R 3·40 in. above the average of the preceding 26 years.

SHIFFNAL.—An unusually wet October (5·32 in.), the most so (with the exception of 1872, when 6·07 in. was registered) for 40 or more years; the R with which September closed continued to fall on the first three days, then a lull till the 9th, when a fall of ·76 in. (unusual from N.) took place; followed by the first frost, on 12th, for three nights, cutting down dahlias and tender plants; after a short interval R again set in on 17th, falling daily (except on 24th and 25th) to the 29th. The fall from evening of 18th to morning of 21st was incessant, amounting to 2·47 in.; wherever streams run the land was greatly flooded. In spite of the cold R, figs ripened on the outer walls, owing to the warmth of the early season. Most of the R came from the N.E. or S.E. Bar. remarkably equable throughout.

ORLETON.—A very cloudy, wet, and gloomy month, with several great and long continued falls of R; the total fall (5·94 in.) is the greatest ever registered, in the same month, since 1830. Only twice in the 45 years has it reached 5 in., viz., in 1848, 5·04 in., and 1855, 5·72 in. The river Teme was frequently full, and was much flooded on 20th and 21st. Bar. was uniformly low till the 8th, and very steady. The first week was warm, but generally cloudy; the remainder of the month was cold, with very little sunshine, the mean temp. of the month being below the average.

LEICESTER.—On 9th, an unusually heavy fall of R (2·24 in.), lasting 10 hours, and causing a very high flood; the heavy fall (·81) on the 20th also caused a flood, but not so high. Exactly 22 in. of R have fallen since the 1st of June.

BOSTON.—The floods, which have been so destructive in other parts of England during the month, have not been felt in this neighbourhood. A strong freshet has been running down the Witham, but the waters have not risen sufficiently to flood any of the land; the excellent arterial drainage of the Fens has proved to be thorough, and clearly shows what can be done to regulate the storage and discharge of the rainfall.

GRIMSBY.—9th, the fine weather broke up this day; the bar. falling with a N. wind; whilst the clouds were coming from S. Woodcocks arrived on 15th; wild swans seen on the Humber on the same date; a pair of grey crows seen on 19th. L in the N.E., at night, on 22nd. The end of the month very cold and wet. Foot and mouth disease still very prevalent amongst cattle.

WALES.

HAVERFORDWEST.—A very stormy, wet month, almost incessant R, with violent gales, especially at night; no single fall of great magnitude (·80 in., on 22nd, being the max.). Cold easterly winds, with much downfall, during the last 14 days of the month. No frosts, except slight white ones on a few mornings.

LLANDUDNO.—The general character of the month was cold and wet, though eight days are entered in my register as very fine. Rainfall nearly an inch in excess, and the temp. 1°·3 below the average. Greatest fall was ·85 in. on 11th, with T and L.

SCOTLAND.

DUMFRIES.—The fall of R has been about the same as that of October, 1874; the temp. is half-a-degree less. There was hoar frost on several mornings in the early part of the month; once H, and twice T. The month generally has been wet and disagreeable.

HAWICK.—A wet month, with cold E. winds. Frost on the nights of the 11th and 12th. Potatoe crop fully half lost from the disease.

ANNANHILL.—Bar. pressure and temp. below that of last month; R moderate; winds principally E. and S E. Several gales during the month; strong gale on the night of the 5th; S.W. and S.E. gales on 10th, 20th, and 22nd. Limes, planes, oaks, &c., divested of leaves. Pastures still fair, but foot and mouth disease prevalent to some extent. Scarlatina also prevalent in the district.

CASTLE TOWARD.—A dull, disagreeable month throughout, with cold piercing winds; being easterly most of the month; every advantage was taken of it for lifting potatoes. Turnips look well, and every appearance of a good crop. Fruit trees casting leaves earlier this season. The forest trees also are bare, and everything has a wintry look.

BRAEMAR.—An unusually wet, damp month, just double the average amount of R.

ABERDEEN.—T and L at 5 a.m. on 12th; bar. pressure below the average (19 years) temperature, and rainfall above it; E. and S.E. winds greatly in excess of average. A wet and stormy month, with a comparatively high temperature; heavy easterly gales, with little intermission, from 14th to 31st.

LOCHBROOM.—Our September was beautiful, but nothing could exceed this month, especially down from the 12th to the 31st, during which time we have only had ·09 in. of R.

PORTREE.—The first 10 days were wet, but none of the gales that were so much felt on the S.E. and N. coasts reached here. Heavy H on 6th; frost every day from 13th to 17th. The crops are all secured, and much above the average. Potatoes very abundant, and are now selling at 3d. per stone. Cattle and sheep well, and thriving well on the pastures.

CULLODEN.—L on nights of 2nd and 6th. Auroræ on seven nights. Thick fogs on the mornings of 12th and 13th.

SANDWICK.—The rainfall of October has been fully an inch less than the average of the last 34 years, while there have been great floods in various parts of England. The most remarkable feature of the month was the persistence of S.E. winds, which commenced here on the morning of the 13th, and not only blew to the end, but still blow, after completing three weeks; it never exceeded about 40 miles an hour here, but its continuance, without intermission, put the German Ocean in an awful rage, while the Atlantic on our western shores has been as smooth as a lake.

IRELAND.

DARRYNANE.—Rainfall about the average; wind variable, generally moderate, but on 3rd a gale from S.W.; 5th and 6th from N.W.; also on 9th and 11th; from S.E. on night of 17th and 18th; also on 28th and 29th. Sea generally rough; last few days very foggy. Starlings migratory here seen on 15th; blackbirds (also migratory) on 19th; woodcocks on 17th.

WATERFORD.—25th to the end, winds varying during these days, from N.E. by E. to S.E. and S., but with a min. temp. never below 45°, but on two occasions 50°, and on others 49° and 48°.

MONKSTOWN.—The heaviest monthly rainfall I ever registered since I commenced in 1864; the last week is unparalleled in quantity, almost 3 in. in three days; the total for the week being 4·13 in. This month is also noteworthy from the fact that on two occasions upwards of 1·00 in. of R fell in 24 hours. The bar. has been fairly high during all the R, which came with a south-easterly wind.

BALLYSHANNON.—The month has been chiefly marked by high winds and low temperatures. River Erne unusually swollen for this season, owing to constant heavy R.

WARINGSTOWN.—Wet and stormy, except the second week, which was very fine. Temp. rather above the average.

EDENFELL, OMAGH.—Weather generally rainy, though not remarkably so till the last week, when during three consecutive days, nearly two and a quarter inches fell. We have, however, been saved in the N.W. of Ireland from the great damage occasioned elsewhere, by the fact of the R having come to us from the S.E., which from the clouds having to pass over so much land had deposited their burden before reaching us.

[CARDIFF, ELY.—Our readers have, doubtless, noticed that the returns from this station frequently arrive too late for insertion, in fact have this year only been published for the months of March, April, and July. We regret to find that even of these that for July was incorrect, the return from another station, near Cardiff, having been substituted for that from Ely, which had not arrived. The amount at Ely was 7·21 in. on 18 days.—ED.]

SUPPLEMENTARY TABLE OF RAINFALL IN OCT., 1875.

[For the Counties, Divisions, Latitudes, and Longitudes of these Stations, see Met. Mag., Vol. X., p. 28.]

Station.	Total Rain.	Station.	Total Rain.
	in.		in.
Acol	2·59	Gainford	4·37
Hailsham	4·47	Shap	4·72
Strathfield Turgiss	5·85	Llanfrechfa	...
Addington Manor	6·18	Castle Malgwyn	4·66
Oxford	7·41	Heyope	7·24
Cambridge	3·07	Melrose	3·26
Sheering	3·49	Cessnock, Glasgow	5·83
Ipswich	3·51	Gruinart	6·49
Diss	3·30	Keith	3·14
Swaffham	2·58	Strathconan	4·42
Compton Bassett	7·66	Springfield, Tain	2·05
Hessary Tor, Dartmoor	10·50	Skibbereen	5·88
Teignmouth	8·69	Fermoy	7·51
Torrington	6·59	Kilrush	6·63
Trevarrick, St. Austell	9·33	Kilkenny	5·90
Taunton	7·30	Kilsallaghan	6·50
Cheadle	6·39	Twyford, Athlone	4·39
Ashby de la Zouch	5·53	Ballinasloe	3·86
Coston, Melton Mowbray	5·48	Kylemore	8·06
Bucknall	4·40	Bangor	5·39
Mansfield	5·03	Carrick on Shannon	3·93
Walton, Liverpool	4·83	Warrenpoint	7·86
Broughton-in-Furness	7·61	Bushmills	5·19
Stanley, Wakefield	3·93		